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CONTROL OF BRUGIAN FILARIASIS IN SHERTALLAI, SOUTH INDIA: PRE-CONTROL EPIDEMIOLOGICAL OBSERVATIONS.

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ABSTRACT

The Vector Control Research Centre (VCRC) has undertaken a project for control of Brugian filariasis in Shertallai, Kerala, South India. The pre-control epidemiological features of endemic Brugian filariasis in the were studied by conducting filariometric surveys in 1986. Of the 22,369 persons examined for night blood microfilaria, 517 (2.31%) were found positive. In the clinical survey, 7,197 persons were examined and 716 were found to have filarial manifestations, accounting for a disease prevalence rate of 9.9%. The infection and disease prevalence was not homogenous in different parts of Shertallai. The prevalence recorded in western areas was higher compared to others. Age infection and age intensity profiles showed a monotonic rise until about 20 years, following which there was a decline, to become relatively stable in older age groups. Disease prevalence was lower than infection prevalence in early childhood and showed a monotonic rise throughout all age classes. The frequency distribution of microfilaria counts was overdisposed, but was not adequately described by negative binomial probability distribution. Comparison of results of present study with earlier studies showed that the prevalence of filariasis is on the decline.

INTRODUCTION

Of the vector borne diseases lymphatic filariasis is a major public health problem in India (Sharma et al. 1983).The Vector Control Research Centre (VCRC) is involved in the devlopement of appropriate strategies for the control of lymphatic filariasis in South India. One of the major activities of VCRC has been the control of Bancroftian filariasis (Rajgopalan and Das, 1984; Rajagopalan and Das, 1985; Rajagopalan and Das, 1986; Rajagopalan and Das, 1987; Rajagopalan et al., 1987) but in 1986 a new programme was initiated to control Brugian filariasis. This technology mission project aims to control disease transmission in the Taluk (a sub-division of a District) of Shertallai in Kerala State, South India. The extent of the filariasis problem in this Taluk is indicated by the fact that the elephantoid swelling of the legs due to filariasis is commonly referred to as "Shertallai leg" in South India .

The pattern of transmission of Brugian filariasis is different from that of Bancroftian filariasis. The *Mansonia* mosquitoes *(M.annulifera, M.uniformis)*, the vectors for Brugian filariasis, breed in hydrophyte infested water bodies which are predominantly found in rural areas. Hence the disease distribution is predominantly rural in contrast to Bancroftian filariasis, where the distribution is associated with the predominantly polluted water breeding sites of the *Culex* vector in urban areas. The VCRC has adopted an integrated disease vector management (IDVM) strategy to control Brugian filariasis based on environmental manipulation to reduce mosquito breeding, and treatment of parasite carriers. The progress of these activities has been documented in earlier reports (VCRC Annual Reports 1986, 1987). The present article describes the epidemiological features of endemic Brugian filariasis in Shertallai as determined by pre-control surveys.

METHODS

Shertallai Taluk is located at 09^0 42' latitude north and 76^0 20' longitude east in Kerala state of South India (Fig.1). The Taluk lies on a peninsula between the Arabian sea to the west and the Vembanad lake to the east. The area is highly waterlogged; there are an estimated 75,000 ponds and over 390 kms.of canals and channels. These waterbodies are infested with the hydrophytes *Pistia stratiotes, Eichornia crassipes, E. speicosa, Salvinia molesta.* These hydrophytes support the breeding of the *Mansonia* mosquitoes which transmit

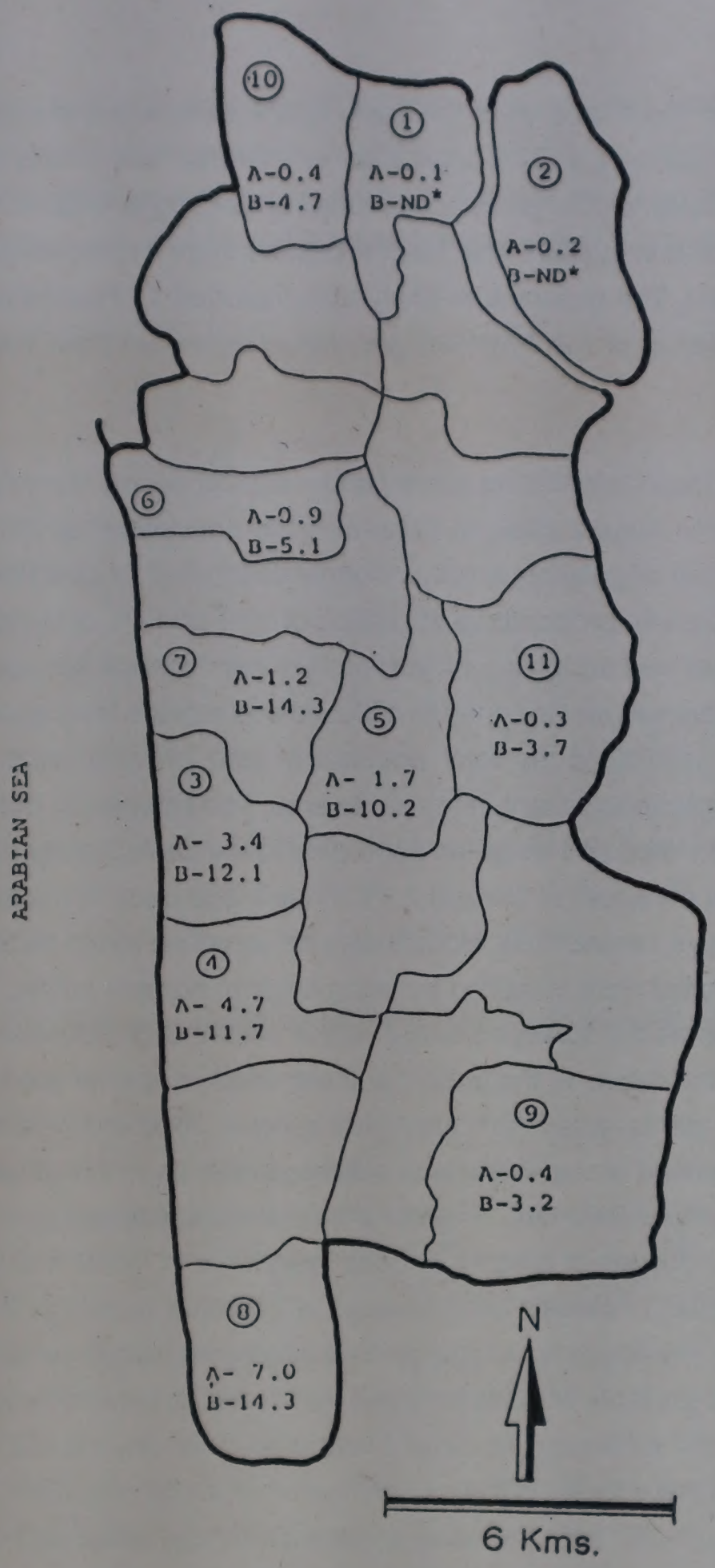

Figure 1. Map of Shertallai Taluk showing the Panchayat-wise microfilaria (A) and disease (B) prevalences in percentage (N.D:Not done)

Brugian filariasis. The total area of the Taluk is 304 sq.kms and the population density is 1297 per sq.km. The population is more or less evenly dispersed throughout the Taluk which has only one small urban agglomeration, the Shertallai town (population 40,000). The Taluk is divided into 18 administrative areas called Panchayats. The programme study area included 11 Panchayats covering a total population of 158,700(1986 population estimated from 1981 census population).

A peripheral blood microfilaria survey and a clinical survey were conducted during February to August 1986, to determine the pre-control epidemiological situation. Since the population is not uniformly distributed, a stratified random sampling protocol with proportional allocation of 10% and 3% of the population of each Panchayat was adopted for the microfilaria and clinical surveys, respectively. The programme was designed to collect blood smears from approximately 15,900 persons(10% of the total population) and clinically examine 4800 persons (3% of total population) in the study area. The samples in both the surveys were age stratified and weighted according to the demography of the area, with a target of a minimum of 5% and 2.5% in each age class in the microfilaria and clinical surveys, respectively. Households for sampling within each of the 11 Panchayats sampled were identified by using random number tables.

On the day before the surveys a social worker visited each household and informed them of the details of the project and recruited people for the study. The blood collection teams visited the households between 2000 and 2400 hours and a 20 mm^3 pheripheral blood smear was collected from each individual for subsequent laboratory assessment. All microfilaria carriers detected, were treated with DEC (at the dosage of 6mg/kg of body weight for 12 days) and thereafter followed in the VCRC Filariasis clinic situated at Shertallai town. For the clinical survey a team of physicians accompanied by sociologists visited the households and examined all available persons for filarial manifestations in addition to enquiring about the clinical history . Treatment was offered for any clinical condition diagnosed. The clinical cases of filariasis were also referred to the VCRC Filariasis clinic for follow-up. For both the surveys permission was obtained from all individuals, or in the case of children their guardians.

RESULTS

A total of 22,369 blood smears (14.1% of the total population) was collected and examined for microfilaraemia. In the clinical survey 7,197 persons (4.5% of

total population) were examined for filarial disease manifestations. The age stratification of the samples in both the surveys resembled the age-distribution of the population with the exception of the 0-5 years age-class in the clinical survey which was slightly under-target sample size (Fig.2 and Table 1.).

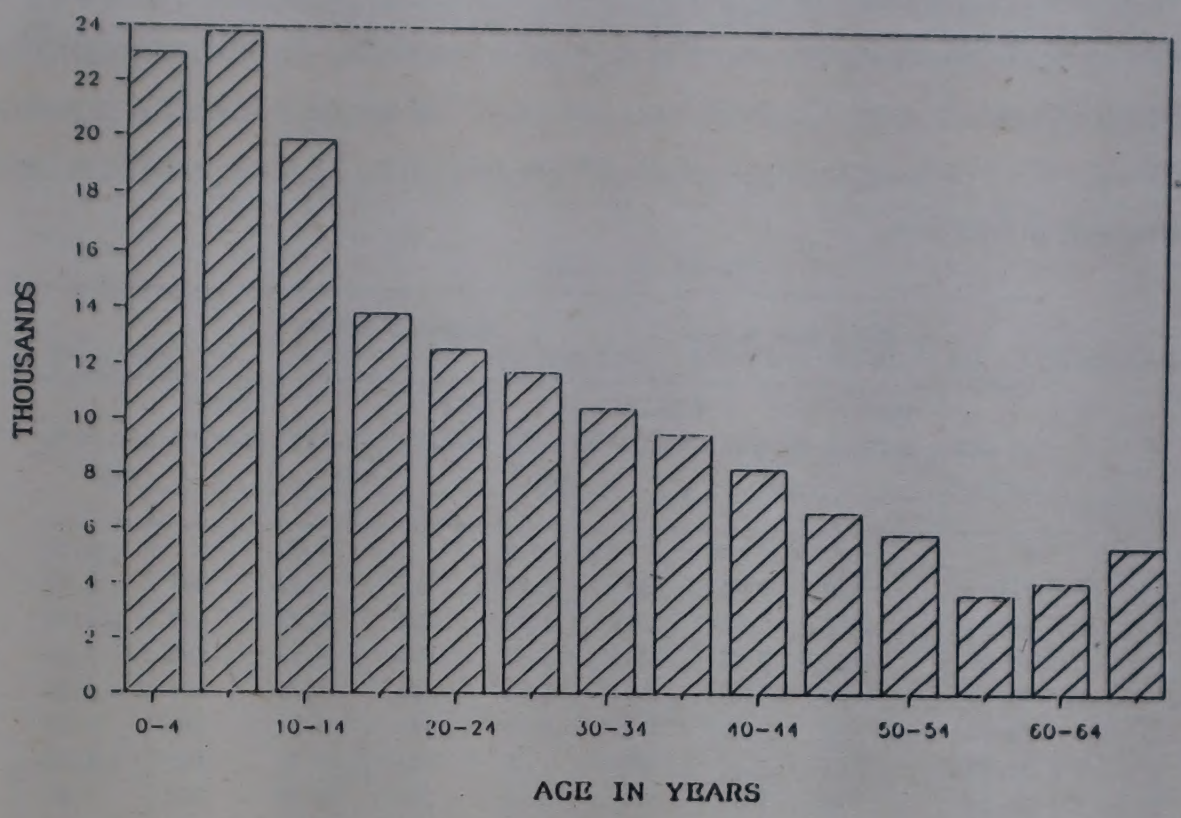

Figure 2. Age-Structure of population of study area

	MICROFILARIA SURVEY		CLINICAL SURVEY	
AGE GROUPS (years)	SAMPLE SIZE	% OF THE POPULATION	SAMPLE SIZE	% OF THE POPULATION
0-4	1160	5.04	559	2.43
5-9	2098	8.81	809	3.40
10-14	2665	13.43	781	3.94
15-19	2686	19.45	712	5.16
20-24	2379	18.98	659	5.26
25-29	1807	15.39	576	4.90
30-34	1756	16.77	523	4.99
35-39	1573	16.52	441	4.63
40-44	1015	12.30	288	3.49
45-49	1214	18.21	342	5.13
50-54	974	16.59	316	5.38
55-59	955	26.16	298	8.16
60-64	925	22.42	319	7.73
>64	1162	21.53	574	10.64
TOTAL	22369	14.10	7197	4.53

Table 1. Age distribution of samples in microfilaria and clinical surveys in study population

Overall patterns of infection and disease:

The prevalence of microfilaraemia increased monotonically in both sexes in childhood and throughout the young adult age-classes to attain a peak approximately at 20 years of age (Fig.3). The infection prevalence declined from 20 years to approximately 35 years of age and thereafter remained relatively stable throughout adulthood. Comparison between the sexes showed a significant difference only in the age-range of 25-34 years (Table 2), with infection being less prevalent in females.

	MICROFILARIA SURVEY				CLINICAL SURVEY			
	MALE		FEMALE		MALE		FEMALE	
AGE GROUP (years)	SAMPLED	MF.RATE (%)	SAMPLED	MF.RATE (%)	SAMPLED	DIS.RATE (%)	SAMPLED	DIS.RATE (%)
0		0		0		0.00		0.00
1-4	630	0.95	530	0.75	272	0.00	287	0.00
5-9	1063	1.22	1035	2.03	391	0.77	418	1.20
10-14	1352	3.25	1313	3.12	353	2.83	428	2.80
15-19	1159	3.80	1527	3.73	233	3.00	479	6.26
20-24	927	2.80	1452	2.55	171	2.34	488	5.53
25-29	716	3.07	1091	1.28	136	11.76	440	6.36
30-34	716	2.51	1040	0.96	125	8.80	398	9.05
35-39	679	2.50	894	2.24	141	14.18	300	9.33
40-44	440	2.50	575	1.22	87	11.49	201	12.94
45-49	493	2.43	721	1.39	95	11.58	247	14.57
50-54	424	2.59	550	1.64	110	17.27	206	21.84
55-59	430	2.09	525	3.05	91	20.88	207	24.15
60-64	426	2.35	499	1.40	115	23.48	204	25.98
>=65	562	2.14	600	1.50	222	34.23	352	30.40
TOTAL	10017	2.55	12352	2.12	2542	9.17	4655	10.38

Table 2. Age and sexwise infection and disease prevalence in study area

The age-intensity of infection was measured as mean microfilarial density, which also increased monotonically in both sexes from childhood until approximately 20 years of age. Above 20 years the intensity declined sharply until approximately 30 years and thereafter remained relatively stable (Fig.4). In general, the age-intensity profiles in both sexes showed a similar trend as age-prevalence.

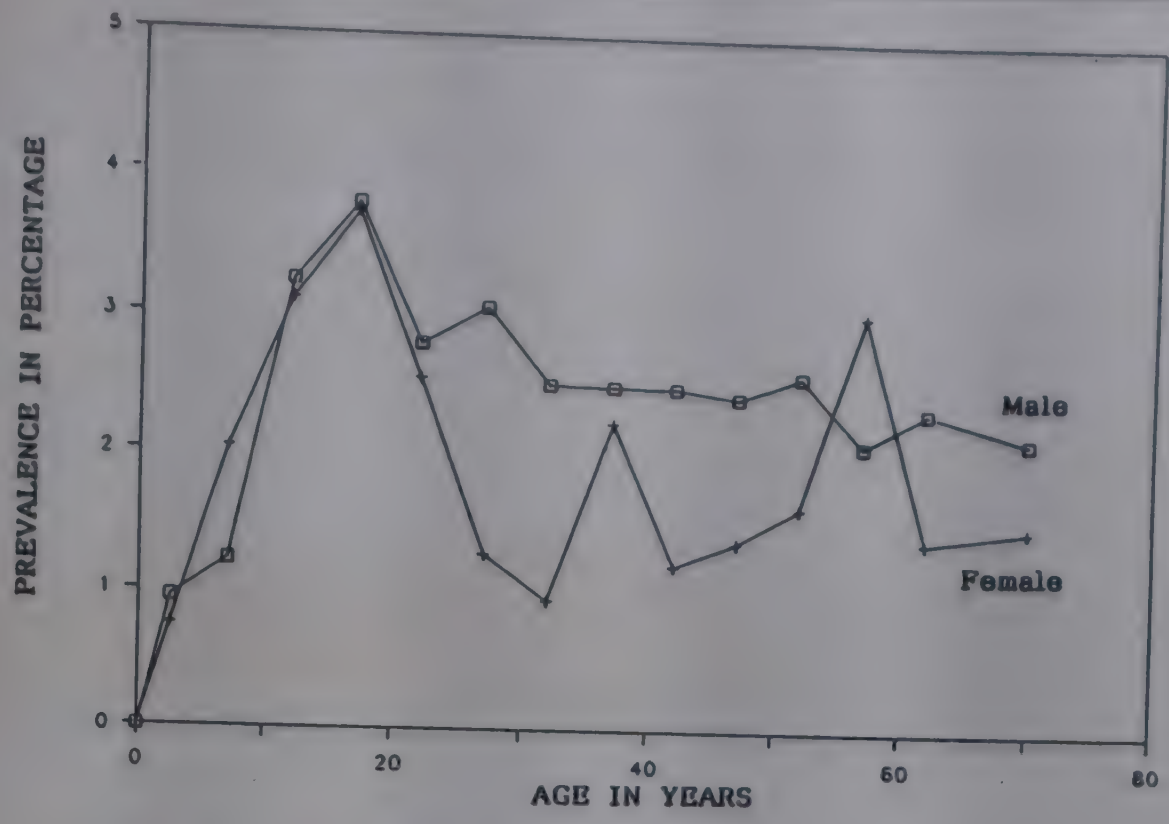

Figure 3. Age and sexwise prevalence of infection

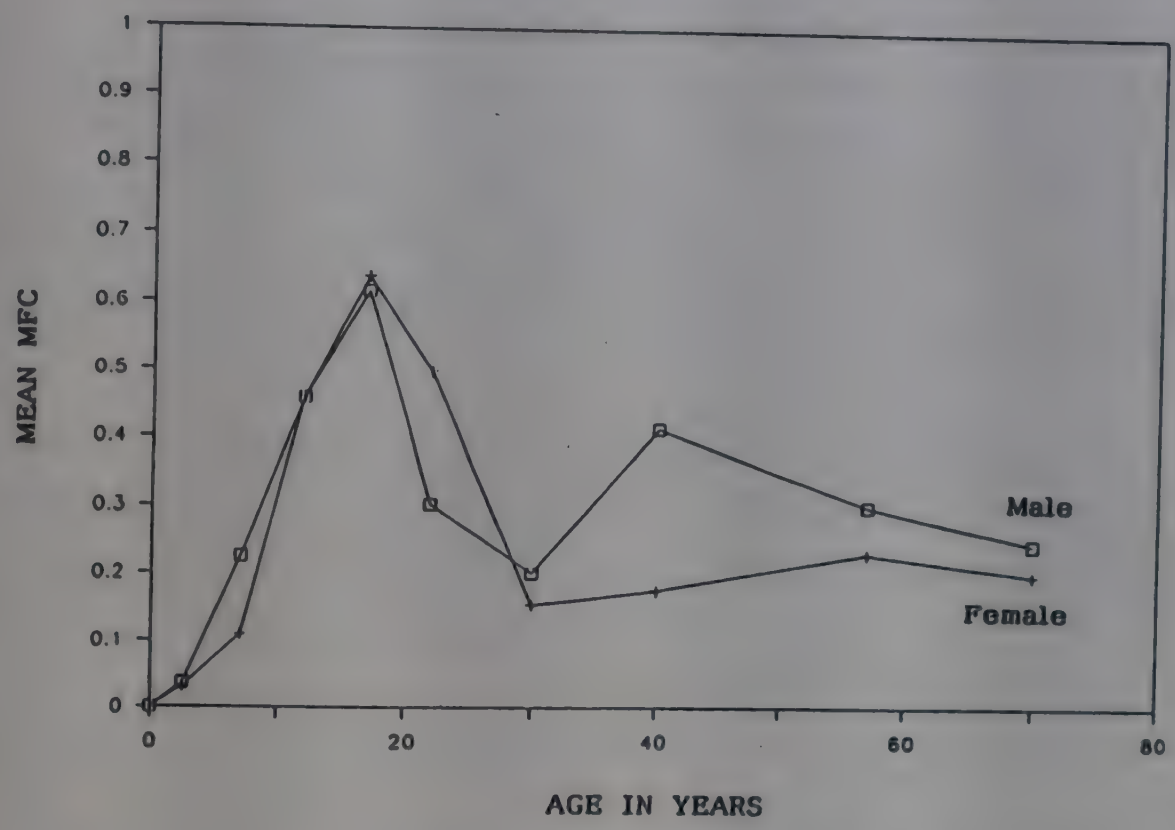

Figure 4. Age and sexwise intensity of infection

The frequency distribution of microfilarial counts showed a markedly overdispersed pattern (Fig.5). While the microfilaria counts ranged between 1 to 140 per 20 mm^3 blood, the mean infection intensity was 0.31 per 20 mm^3 in the study population. The frequency pattern of microfilarial counts was not adequately described by the negative binomial probability distribution.

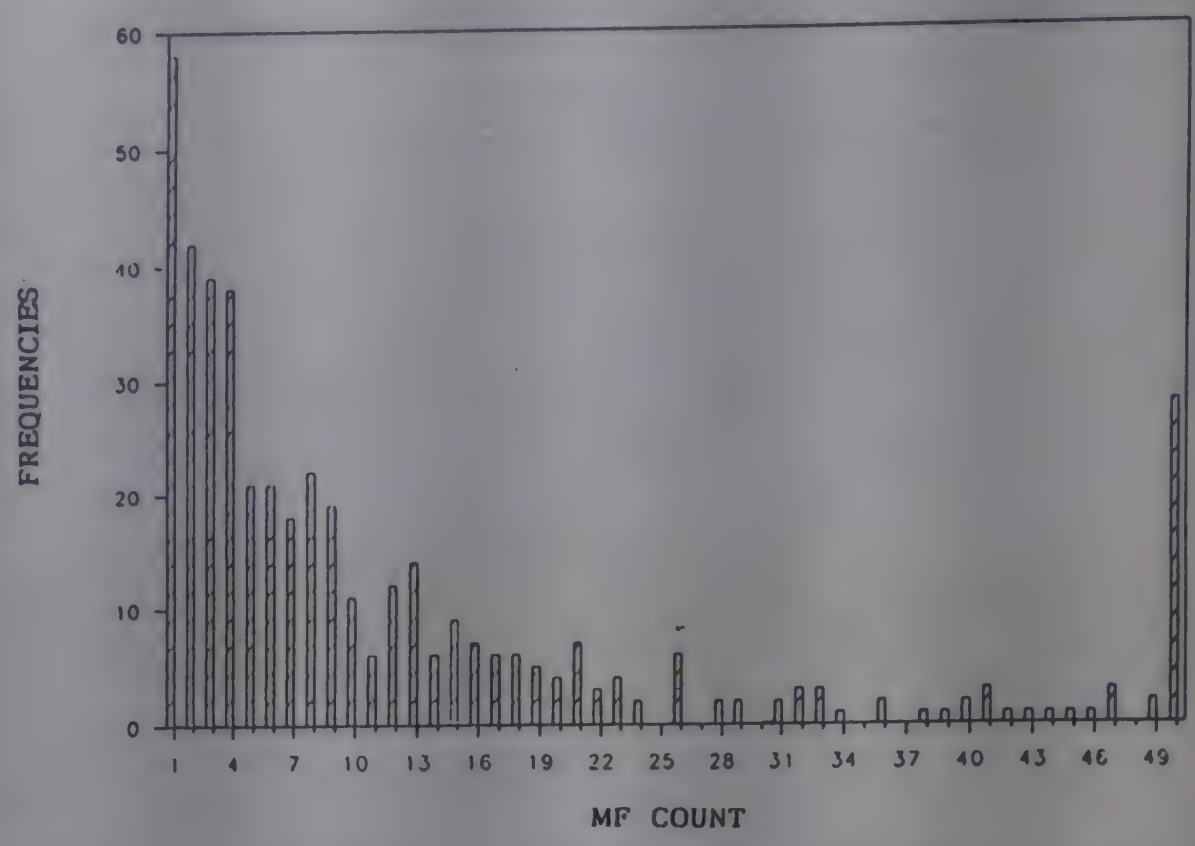

Figure 5. Frequency distribution of microfilaria counts in infected individuals.

The prevalence of disease was measured by taking into consideration both acute and chronic manifestations of filariasis using standard diagnostic criteria (Manson-Bahr and Bell, 1987). Of the 7,197 persons clinically examined 716 had definite clinical manifestations of filariasis accounting for a disease rate of 9.9%. The prevalence of disease was clearly age-dependent in both sexes (Fig.6).

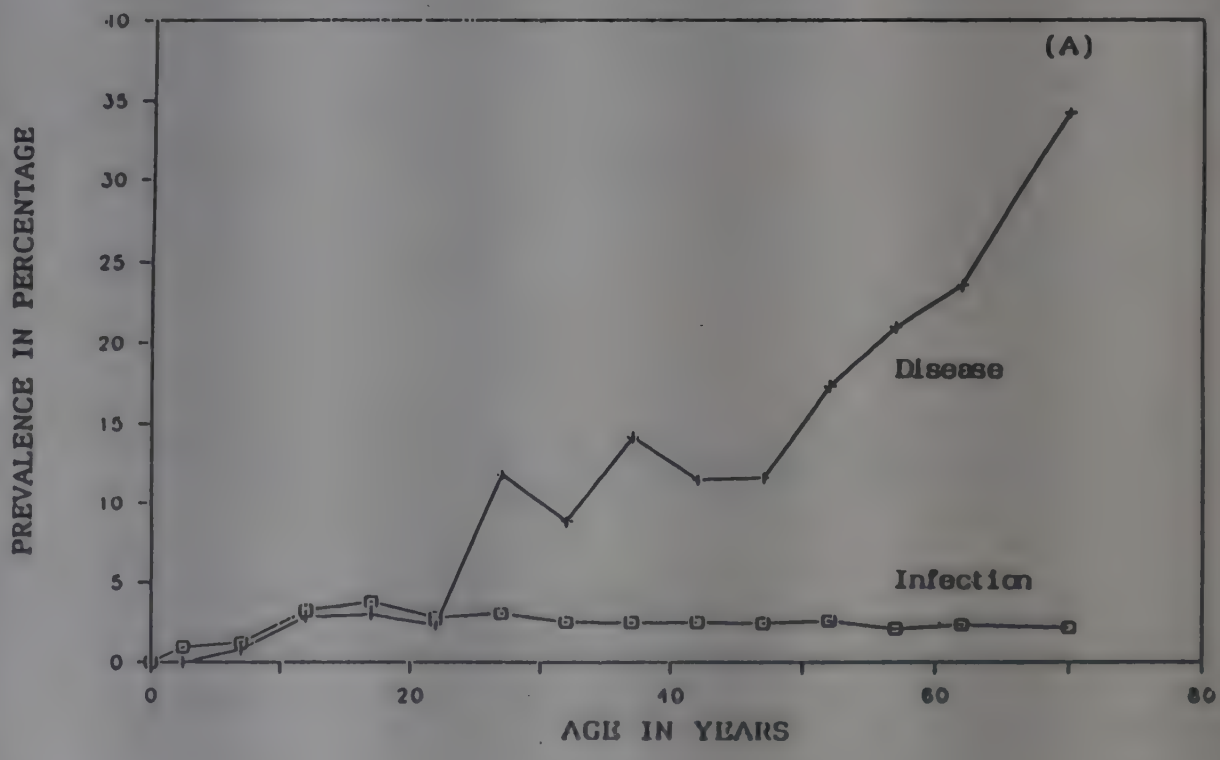

Figure 6.A Agewise comparison of infection and disease prevalence in males.

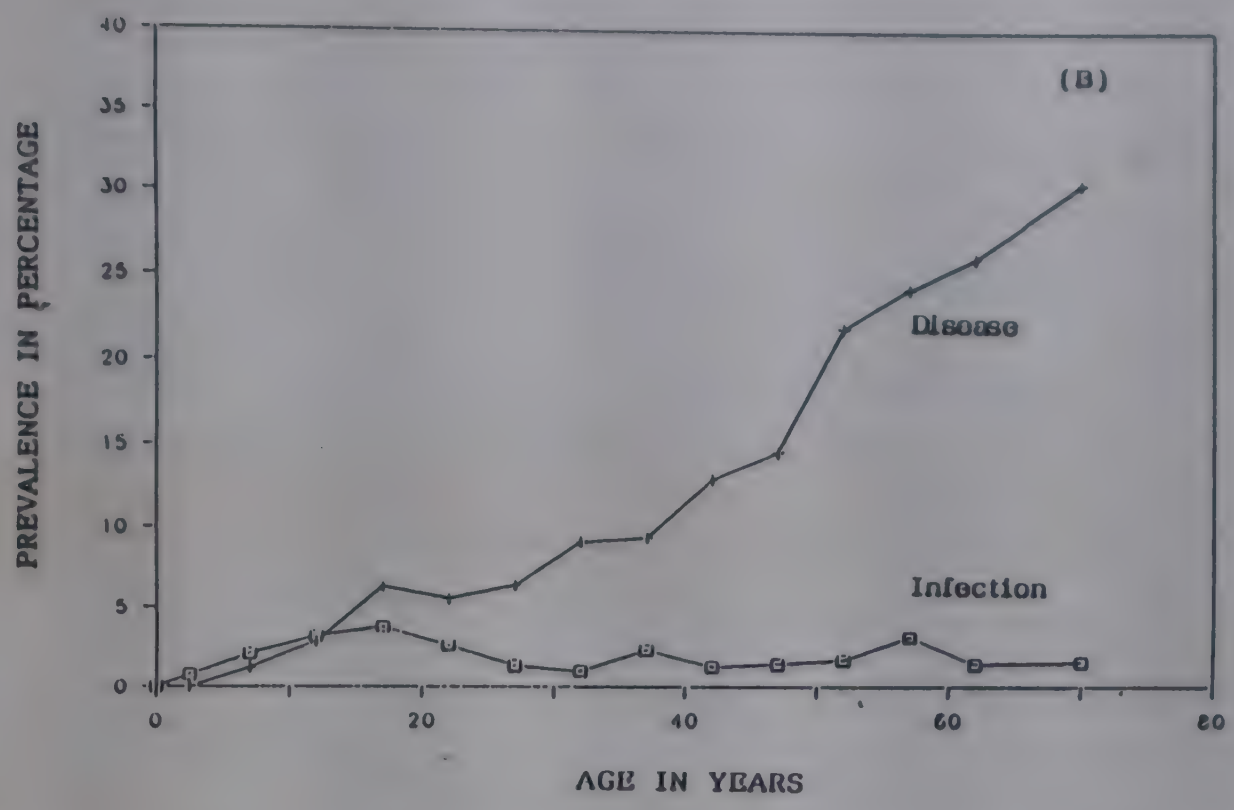

Figure 6.B Agewise comparison of infection and disease prevalence in females.

Disease prevalence was lower than infection prevalence until about 15 to 20 years, thereafter the disease prevalence showed a monotonic increase in both sexes while the microfilaria prevalence remained low and relatively stable. Comparison between females and males did not show significant differences in disease prevalence in any of the age classes. Chronic lymphodema of the lower limbs was the predominant clinical presentation in both sexes.

Spatial distribution of infection and disease:

Comparison of infection and disease prevalence in different Panchayats showed that the distribution of filariasis was not spatially homogeneous in the study area (Fig.1 and Table 3).

The Panchayats in the Western part of Shetallai Taluk adjacent to the Arabian sea showed a higher prevalence rate compared to the Eastern or Northern Panchayats. The pattern was similar for both infection and disease prevalence. Comparison of the age prevalence of infection in 7 of the 11 Panchayats showed considerable variation in the different areas (Fig.7), although the age profiles of areas with significant prevalences of infection were qualitatively similar.

AREA.NO	PANCHAYAT NAME	POPULATION	MICROFILARIA SURVEY SAMPLED	% COVERAGE	CLINICAL SURVEY SAMPLED	% COVERAGE
1	AROOKUTTY	14080	1883	13.37	ND	ND
2	PERUMBALAM	8990	1116	12.41	ND	ND
3	KADAKARAPALLI	16165	2208	13.66	638	3.95
4	SHERTALLAI SOUTH	32921	6717	20.40	3990	12.12
5	VAYALAR	20698	2612	12.62	607	2.93
6	KUTHIATHODE	18531	2248	12.13	553	2.98
7	PATTANAKAD	6223	752	12.08	112	1.80
8	MARARIKULAM	3510	389	11.08	154	4.39
9	MUHAMMA	14402	1748	12.14	315	2.19
10	AROOR	6970	698	10.01	233	3.34
11	PALLIPURAM	16210	1998	12.33	595	3.67
TOTAL		158700	22369	14.10	7197	4.53

ND-not done

Table 3. The population and sample distribution according to geographical areas (Panchayats).

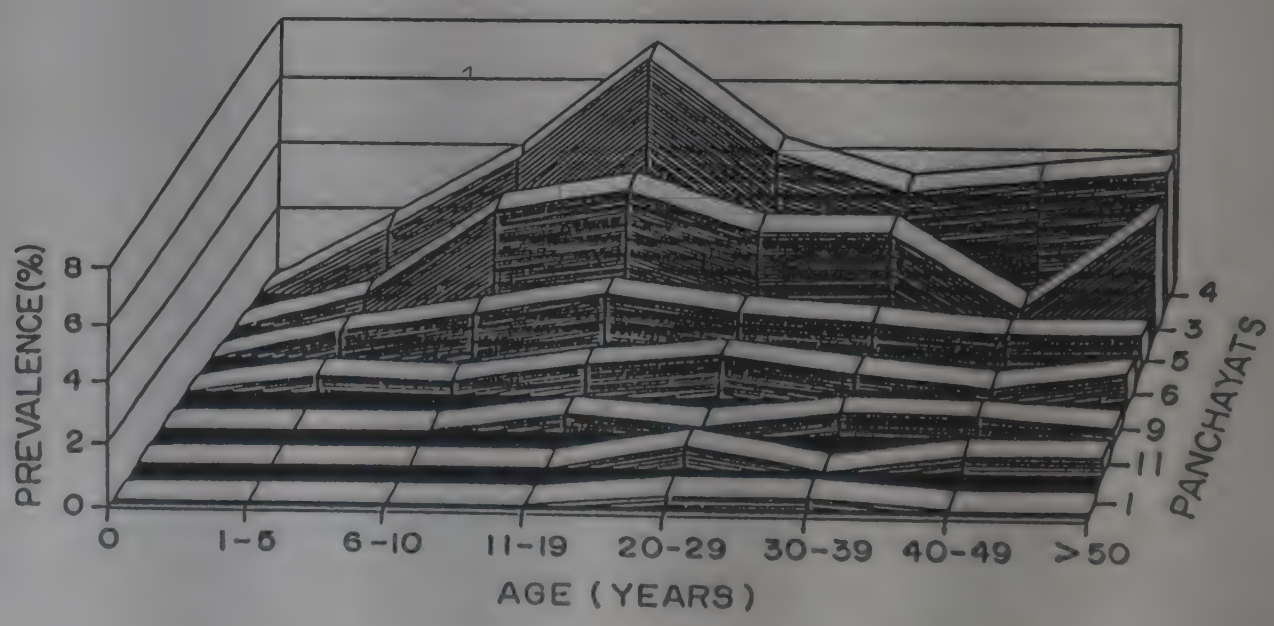

Figure 7. Agewise infection prevalence in selected Panchayats. (For Panchayat numbers, refer Table 3 and Figure 1)

Comparison with previous studies:

Comparison of a series of studies from 1934 (Iyengar,1938 ; Jaswant Singh et al. 1956 and Russel et al. 1976) to the present in 2 of the 11 Panchyats, showed that there has been a significant decline in the prevalence of both infection and disease over the last five decades (Fig.8).

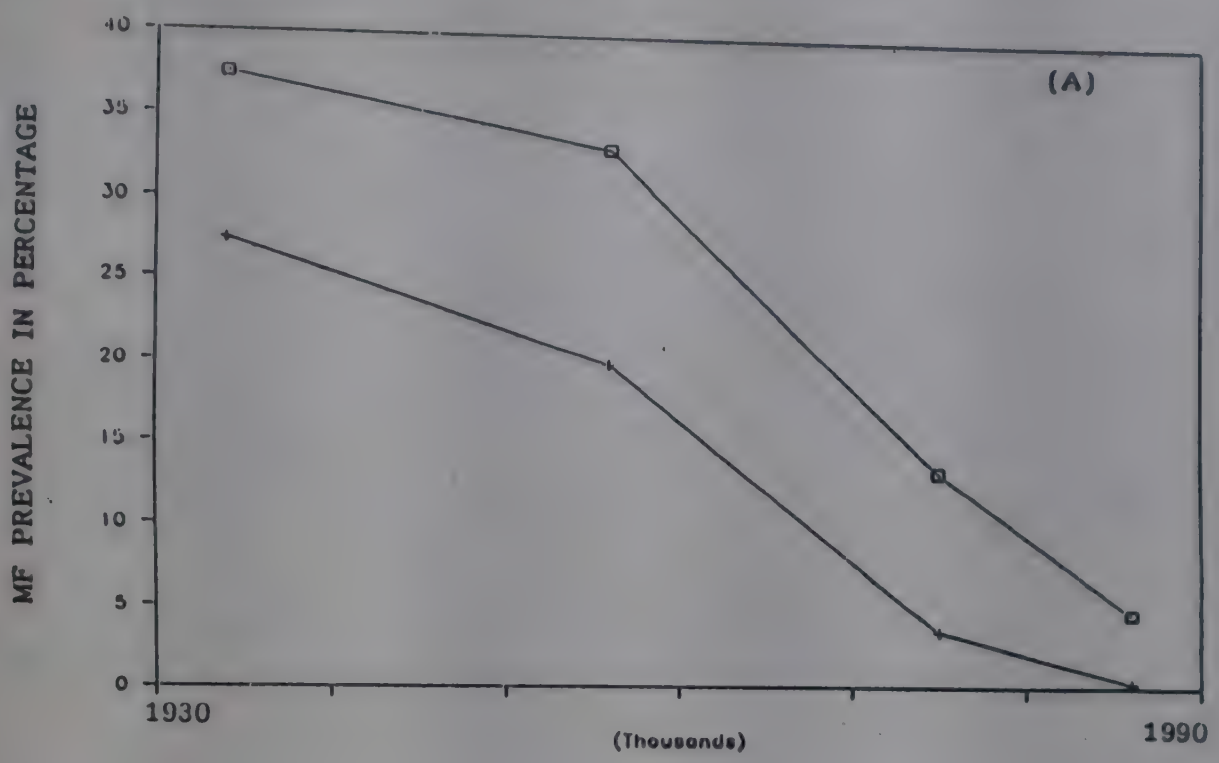

Figure 8. Pattern of change in infection (A) and disease (B) prevalences in two selected Panchayats between 1934 and 1986.

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When the study area was divided into three zones,to observe the geographical pattern of decline over the last fifty years, the results indicated that all three zones showed qualitatively similar change (Fig.9). The results also indicated that the prevalence has remained highest in the Western zone throughout the period from 1934 to 1986.

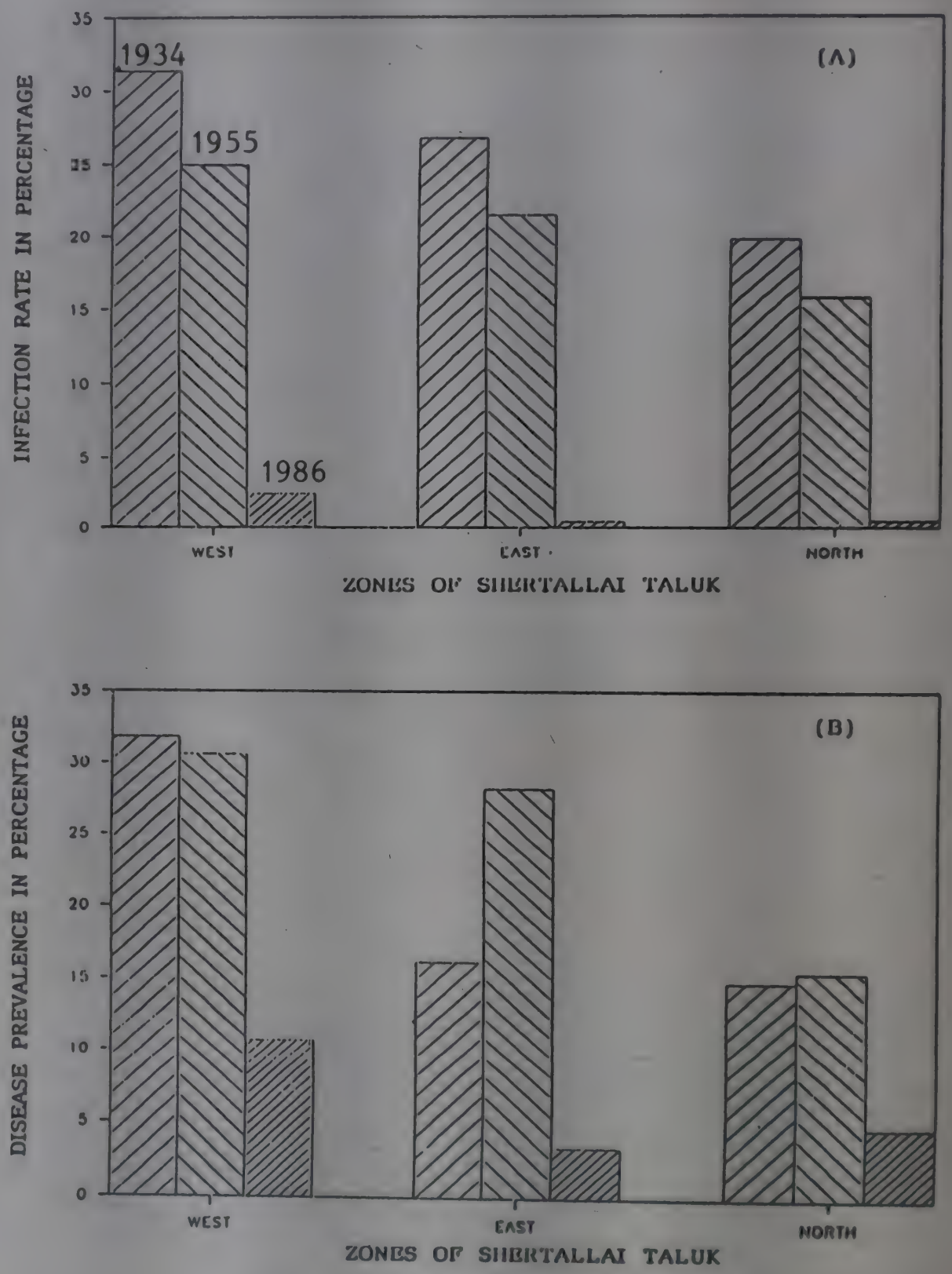


Figure 9. Pattern of change in infection (A) and disease(B) prevalences in three zones of study area.

The comparison of average microfilarial intensity among the infected individuals in 5 of the 11 Panchayats between 1955 and the present study also showed a significant decline (Fig.10).

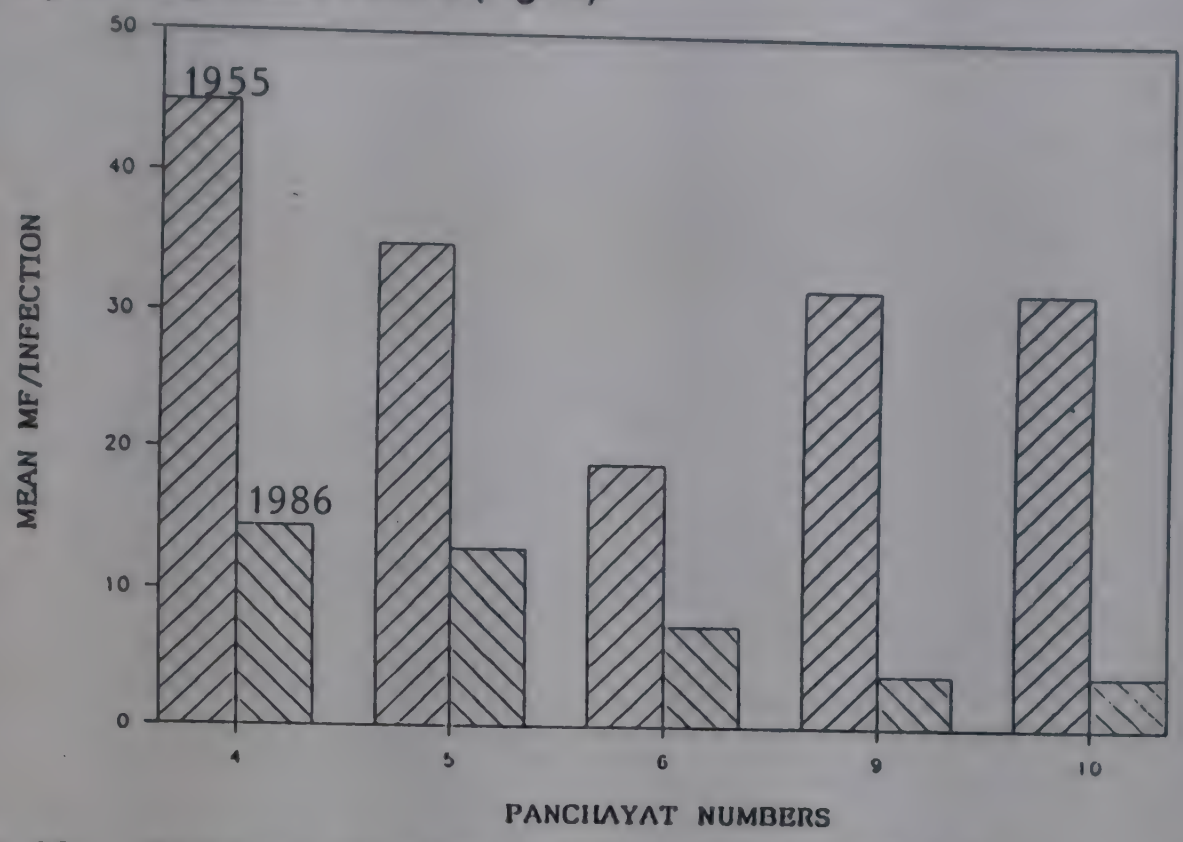
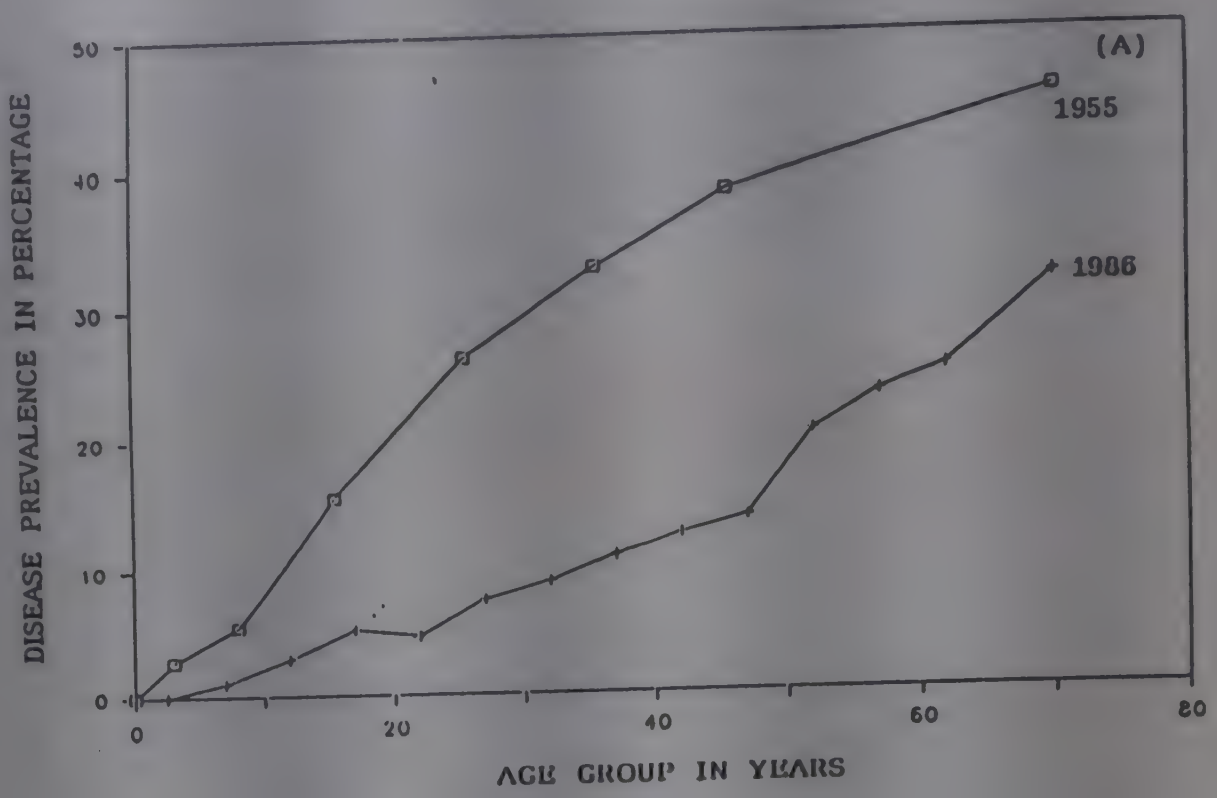


Figure 10. Pattern of change in mean microfilariae counts among the infected individuals in 5 selected Panchayats. (For Panchayat Nos. refer Table 3).

Comparison of the age distribution of microfilaria and disease prevalence again showed a significant quantitative decrease, although the relationship between prevalence of infection and disease remained qualitatively similar in both studies (Fig.6 & Fig.11).

DISCUSSION

The study confirms that Shertallai remains endemic for Brugian filariasis. The distribution of infection was not however homogeneous throughout the Taluk: the prevalence of microfilaraemia ranged between 0.11% to 6.94% in different Panchayats. The prevalence rates observed in the present study are likely to be an underestimate of the actual prevalence, as the peripheral blood smear examination technique employed lacks sensitivity (Mak, 1985 ; Desowitz and Southgate, 1973 and McMahon et al, 1979). More sensitive techniques, such as filter concentration methods were not however considered suitable for the present mass survey application.



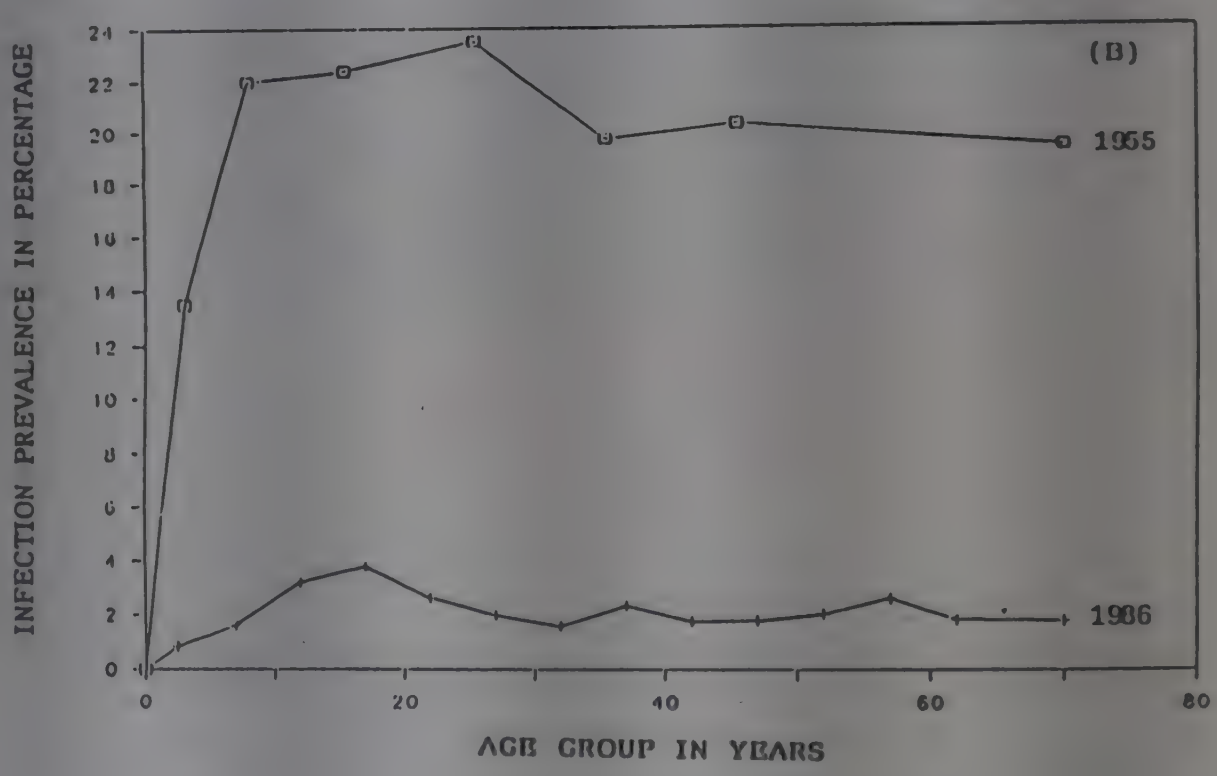


Figure 11. Pattern of change in agewise infection (A) and disease (B) prevalences between 1955 and 1986 in study area.

The pattern of age prevalence showed a qualitative similarity with that observed for Bancroftian filariasis in South India and in other parts of the world (Rajagopalan et al, 1988; Sasa et al., 1970; Beye and Gurian, 1960). It is not known whether the obseved age-dependency is due to the age-dependency of the acquisition of infection or the age-dependency of host resistance. The age intensity profile also resembled that observed for *W. bancrofti* in Pondicherry (Rajagopalan et al. 1988). It has been suggested that the age at which peak intensity of infection is attained is related to the parasite life span (Anderson and May, 1985). The fact that this peak was around 20 years of age for both *B.malayi* (present study) and *W.bancrofti* (Rajagopalan et al., 1988) indicates that the lifespan of adults of both parasites may be similar in human hosts.

The frequency distribution of microfilarial counts also resembled that for *W.bancrofti* observed in an earlier study (VCRC unpublished data), with a larger proportion of microfilaria negative individuals than would be predicted, even when the sampling sensitivity is discounted. The epidemilogical implications of this are under study.

The disease prevalence was higher than infection prevalence throughout the study area. It ranged between 3.17% to 14.29% in the different Panchayats, and the geographical distribution resembled that of infection prevalence. The analysis of rate of change in disease prevalence with age showed a monotonic age-dependent increase. As the chronic manifestations of disease are permanent (unless treated surgically), and as these were the predominant presentations recorded in the present study, the pattern of age prevalence suggest the accumulation of clinical cases with age.

Comparison of the results of the present study with earlier studies indicates a major decline in filariasis prevalence in the locality over the last five decades. The precise reasons for the decline in prevalence are not known. Several factors in combination might be responsible: introduction of DDT during the Malaria control operations initiated in 1959 (Russel et al.1976); introduction of di-ethyle carbamazine (DEC) in the late 1950s (Ramakrishnan et al. 1960); improvements in socio-economic conditions; or enhanced awareness by the community in combination with increased avalability of medicare. It has also been suggested that gradual replacement of *Pistia stratiotes* and *Eichornia speicosa,* the preferred hydrophytes of *M.annulifera*, by *Salvinia auriculata* could be responsible for a decline in vector density and hence infection prevalence(Russel et al. 1976).

These results indicated that despite a considerable fall in infection prevalence, the prevalence of disease in the Taluk remains unacceptably high (Fig.11). The

continuing high prevalence of disease is partly an historical feature: the older age classes represent persons who acquired infection and disease in previous decades when transmission also was high. It is also apparent, however, that conversion to disease is still occuring in the younger age classes (5% of 15 year olds have clinical filariasis) and thus, that current levels of transmission still have a significant clinical impact. It should be recognised in this context that the current level of infection prevalence as estimated by microfilarial positivity is an uderestimate, and the actual prevalence may be substantially greater. The aim of the VCRC programme is to hasten the eradication of disease from the Taluk, particularly the worst afflicted Western Panchayats, since without timely intervention it would appear that Brugian filariasis will remain a significant cause of ill health in some parts of Shertallai for many more decades.

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